UNIVERSITI TEKNOLOGI MARA

ADSORPTION OF MERCURY FROM SIMULATED FLUE GAS USING ACTIVATED CARBON PRODUCED FROM OIL PALM EMPTY FRUIT BUNCH

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Thesis submitted in fulfilment
of the requirements for the degree of
Master of Science

Faculty of Chemical Engineering

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 03rd December 2014 to conduct the final examination of Noor Hidayu Binti Abdul Rani on her Master of Science thesis entitled "Adsorption of Mercury from Simulated Flue Gas using Activated Carbon Produced from Oil Palm Empty Fruit Bunch" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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AUTHOR'S DECLARATION

I declare that the work in this thesis/dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Mercury pollution is a global crisis facing society today because it is a toxic and hazardous element that can severely threaten human health and environment. Activated carbon as an effective adsorbent in capturing elemental mercury from flue gas was used for this research. In this research, activated carbon was produced from oil palm empty fruit bunch (EFB) using physical (steam) activation method and response surface methodology (RSM) is applied in order to maximize the BET surface area. One model has been developed for BET surface area and showed the activation temperature and activation time are the affecting factors for optimum activated carbon production. The optimum operating conditions were calculated using this model to produce activated carbon with relatively large BET surface area (>500 m^2/g). Based on this optimum condition (765°C, 77 min), the experimental value of BET surface area obtained was 720.0 m^2/g, which is in agreement with that predicted from the model (717.6 m^2/g). The activated carbon produced at optimum conditions was used as adsorbent for the mercury removal from simulated flue gas. The effect of flue gas temperature, inlet mercury concentration and types of activated carbon (modified AC and unmodified AC) were investigated throughout this work. Initially, activated carbon showed a good potential for adsorption of mercury at low temperature. However, as temperature increases from 90°C to 180°C, the efficiency of mercury removal decreased. When the inlet mercury concentration was increased, the mercury removal efficiency was increased. The effect of adsorption efficiency on surface modified activated carbon with potassium iodide (KI) was also studied and showed that the presence of I^- ion on the surface of activated carbon increased the percentage removal of up to 99% and concluded that 5 wt% of KI is deemed to be the maximum desirable loading.

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